

ABSTRACT

The use of Railroad Flatcars (RRFCs) as the superstructure on low-volume county bridges has been investigated in a research project conducted by the Bridge Engineering Center (BEC) at Iowa State University. These bridges enable county engineers to replace old, inadequate county bridge superstructures for less than half the cost and in a shorter construction time than required for a conventional bridge. In order to illustrate their constructability, adequacy, and economy, two RRFC demonstration bridges were designed, constructed, and tested: one in Buchanan County and the other in Winnebago County.

The Buchanan County Bridge (BCB) was constructed as a single span with 56-ft-long flatcars supported at their ends by new, concrete abutments. The use of concrete in the substructure allowed for an integral abutment at one end of the bridge with an expansion joint at the other end. Reinforced concrete beams serving as longitudinal connections between the three adjacent flatcars were installed to distribute live loads more effectively among the RRFCs. Guardrails and an asphalt milling driving surface completed the bridge.

The Winnebago County Bridge (WCB) was constructed from 89-ft-long flatcars. Preliminary calculations determined that they were not adequate to span 89 ft as a simple span. Therefore, the flatcars were supported by new, steel-capped piers and abutments at the RRFCs' bolsters and ends, resulting in a 66-ft main span and two 10-ft end spans. Due to the RRFC geometry, the longitudinal flatcar connections between adjacent RRFCs were inadequate to support significant loads, and therefore, transverse, recycled timber planks were utilized to effectively distribute live loads to all three RRFCs. A gravel driving surface was placed on top of the timber planks, and a guardrail system completed the bridge.

Bridge behavior predicted by grillage models for each bridge was validated by strain and deflection data from field tests; it was found that the engineered RRFC bridges have live load stresses significantly below the yield strength of the steel and deflections well below the AASHTO Bridge Design Specification limits. To assist in future RRFC bridge projects, RRFC selection criteria were established for visual inspection and selection of structurally adequate RRFCs. In addition, design recommendations have been developed to simplify live load distribution calculations for design of the bridges. Based on the results of this research, it has been determined that through proper RRFC selection, construction, and engineering, RRFC bridges are a viable, economic replacement system for low-volume road bridges.